This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

47
59

War Department : Document No.

Y OF MICHIGAN
880 4034

SECRET

GAS W

PART IV

THE OFFENSIVE IN GAS WARFARE
CLOUD AND PROJECTOR ATTACKS

U.S. Engineer dept.

T
is publis
[062.1
By order

Official
H. P

COMPILED AT THE
OFFICE OF THE CHIEF OF ENGINEERS

D-19/40

WAR PLANS DIVISION
JUNE, 1918

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

WAR DEPARTMENT:
Document No. 705.
Office of The Adjutant General.

UNIVERSITY OF MICHIGAN
3 9015 00880 4034

WAR DEPARTMENT,
WASHINGTON, *June 5, 1918.*

The following pamphlet, entitled "Gas Warfare—Part IV," is published for the information and guidance of all concerned.

[062.1 A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

PEYTON C. MARCH,
Major General, Acting Chief of Staff.

OFFICIAL:
H. P. McCAIN,
The Adjutant General.

TABLE OF CONTENTS.

Page.

Introduction.. 7

Organization.. 7

Gas tactics.. 8

  Casualties.. 8

  Neutralization.. 9

The cloud attack.. 10

  General principles.. 10

  Cylinders.. 10

  Gases used.. 12

  Preliminary work for a gas cloud attack................ 12

    Reconnaissance.. 12

    Choice of target.. 13

    Transportation of cylinders........................ 13

    Installation.. 14

    Weather conditions.. 15

    Action immediately prior to the attack............ 15

  The attack.. 16

    Tactics.. 17

    Cooperation with other arms........................ 19

    Raids.. 19

  Results obtained.. 19

    Nieuport, October 5, 1916........................ 20

      Sea sector—Fifth Matrosen Regiment........... 21

      Polder sector—First Matrosen Regiment........ 21

      Lombartzyde sector.. 21

      Bamburg sector.. 21

    Monchy, August 30, 1916........................ 23

    Arras, October 8, 1916........................ 24

    Frelinghien, April 29, 1917........................ 24

    Monchy, June 27, 1916........................ 24

  Representative statements of German prisoners......... 25

Projector attacks.. 27

  General principles.. 27

  Description of appliances........................ 27

Projector attacks—Continued. Page.
The gas 28
Installation 29
The attack 30
Tactics 30
Translation of selected German instructions 31
New English "gas-mine" projector 31
Effects of the projector 31
Enemy tactics 31
Protection against gas 32
English 20-centimeter phosgene projectiles 33
Company order of a unit in the Eightieth Reserve Division 34
Order of Seventeenth Bavarian R. I. R., Sixth Bavarian Reserve Division 35
Danger zones 35
Warning concerning gas mines 36
Notes on individual projector attacks 36
Thiepval, September 25–26, 1916 36
Beaumont Hamel and Y Ravine, November 12, 1916. 37
Cherisy, May 5, 1917 38
Wieltje, June 1, 1917 39
Fontaine Wood, June 14, 1917 39
Hooge, July 16, 1917 39
Lens, September 12–13, 1917 40
Dixmude group 40
Gavrelle-Oppy, July 27, 1917 41
Arbre and Hubner farms, Passchendaele, September 18, 1917 42
Havrincourt, October 13, 1917 43

LIST OF ILLUSTRATIONS.

Typical gas cylinder 11
Diagram showing distribution of a section of gas troops 17
Projector ready for firing 29

THE OFFENSIVE IN GAS WARFARE.

INTRODUCTION.

1. Gas warfare has been so highly developed and extensively used in the present conflict that a gas service is now recognized as a necessary and essential element of an army. Gas warfare gives promise of decisive results if its possibilities are recognized and used. The success already attained by the allies in the use of gas makes it imperative that senior officers should realize the nature, scope, and extent of gas warfare and its consequent relationship to other branches of the service.

2. The usefulness of gas in assisting to attain the desired end rests largely on development along the following lines:

(1) Creation of new materials, apparatus, and methods.
(2) Operations on a large scale by specially trained troops.
(3) Tactical use.

ORGANIZATION.

3. The allied offensive in gas warfare at present comprises gas-cloud attacks, projector attacks, and bombardments with trench-mortar gas shell and artillery shell. In all the belligerent armies the first two methods are carried out exclusively by the gas troops and the last method exclusively by the artillery. Trench-mortar gas shell are generally fired by the special gas troops, but in some cases may be allotted to the ordinary trench-mortar batteries.

4. As in the German Army (cf. Part I, p. 14) the allied gas troops are engineers, those of the American Army being organized as a regiment of engineers (the Thirtieth) known as the Gas and Flame Regiment; those of the British Army forming the Special Brigade of the Royal Engineers; the French gas troops being known as Compagnies Z. These troops form complete units and are provided with their own transport.

The British practice is to use the Special Brigade as general headquarters troops, allotting them to lower formations as required, but maintaining a skeleton organization at each army headquarters to deal with the varying numbers of special companies placed at the disposal of the Army commander at any one time.

5. Apart from major operations decided on by the Army commander, lower formations desiring the assistance of gas troops apply for them through the usual channels to Army headquarters, decision as to location and nature of the attack being then arrived at from consultation with the officer commanding special companies. This officer is stationed at each army headquarters.

GAS TACTICS.

6. Gas attacks have two main objects—the infliction of casualties and neutralization.

CASUALTIES.

7. The gassing of the enemy's personnel is by far the most important result at which to aim, as it not only affects the second object—neutralization—but, in addition, reduces the enemy's man power more or less permanently and seriously affects his morale.

Probably a certain number of casualties will always occur as the result of bad gas discipline, but this can not be relied on. Gas casualties can be inflicted by taking the enemy by surprise and causing him to breathe gas before he has had time to protect himself. Even after he has done this, means of inflicting casualties on him may still be found if the type of mask he uses has been closely studied and its weak points ascertained.

8. Gas tactics will vary from time to time according to the nature of the weapons and materials available, the quantities of these materials, and the nature of the enemy's protective appliances.

9. At the present time the offense has three principal aims:

(1) Suprise.
(2) The exhaustion of the enemy's masks.
(3) The penetration of the enemy's masks.

(1) To effect a surprise the utmost care is required. While secrecy in preparation is essential, silence and invisibility of discharge must also be aimed at. Consequently gas operations

should usually take place at night and as much variety as possible be introduced into the method of attack, smoke being obviously a useful accessory.

(2) The exhaustion of the enemy's masks necessitates a discharge of some hours' duration, which involves a large expenditure of material and therefore of much labor in installation.

This method would assume great importance in the event of a siege, in which circumstances the renewal of exhausted mask drums would be impossible. Under these conditions the enemy would be helpless after a few discharges.

(3) The enemy's protection can be penetrated—
  (*a*) By using high concentrations of gas;
  (*b*) By the employment of gases, not necessarily lethal, against which the mask gives only partial protection or none; and
  (*c*) If the mask is defective from rough usage or for any other reason.

NEUTRALIZATION.

10. Even when the enemy is able to recognize a gas attack and to adjust his masks in time, a considerable tactical advantage is still gained by compelling him to retain them in position. Inconvenience is caused, activity restricted, and vision interfered with, especially at night.

Infantry in trenches and dugouts experience serious discomfort from prolonged wearing of masks; digging and carrying are interrupted, owing to difficulty in breathing during exertion; communications are disorganized as the result of guides losing their way; men can not proceed with wiring and similar tasks, while observers, riflemen, machine gunners, and artillery personnel are seriously hampered in the performance of their duties.

11. As a rule more valuable results are to be obtained by the use of gas on active rather than on passive fronts, because not only are better targets to be found on the former, the enemy being in great strength, but, as the result of the disorganization and demoralization caused by artillery bombardment, his protective appliances are in poor condition and facilities for giving the alarm are limited. His losses, moreover, weaken his resistance and thus facilitate the task of the assaulting troops, whose own losses are reduced because the facilities for the employment of weapons are restricted.

Gas can, however, also be usefully employed on defensive fronts to inflict casualties and so reduce the enemy's morale and his reserves of fighting strength.

THE CLOUD ATTACK.

GENERAL PRINCIPLES.

12. The gas-cloud attack is brought about by the liberation of gas from metal cylinders containing liquid gas, which are buried under the parapets of the front-line trenches. Tubes from these cylinders, each provided with a stop attachment, are carried through the parapet, and the gas is liberated through them. The cylinders are usually placed in batteries of three or four, at such intervals that there are from one to two cylinders per meter of front. The gas in them is in a liquid state, but upon being released by turning on the stopcock it volatilizes rapidly and escapes in the form of a dense vapor. This escape of the confined gas may be accompanied by a low whistling sound which is frequently the only warning the opposing side has of the coming attack. The gases used in cloud attacks are heavier than air, and when released under proper atmospheric conditions move, or rather appear to roll, along the ground, usually in the form of a greenish yellow cloud, toward the lines of troops to be attacked. When it reaches the trenches, the cloud tends to settle down into all parts of them, penetrating the dugouts and bomb proofs, where it sometimes remains for many hours.

13. The purpose of the gas cloud is to kill or maim through asphyxiation, and for this purpose it is made as concentrated and as deadly as possible. This is accomplished by a suitable choice of gas, by employing a sufficiently large number of cylinders and by effecting surprise, so that the unprotected enemy, or those with defective protection, inevitably become casualties.

CYLINDERS.

14. The cylinders used are of the type shown in figure I. The size and shape vary in the different armies, but limits of weight of full cylinders range from 100 to 140 pounds, the liquid gas contained weighing from 50 to 70 pounds. The British type of cylinder is 45 inches long and 8½ inches in diameter. The cylinders are made of one-piece steel, and are

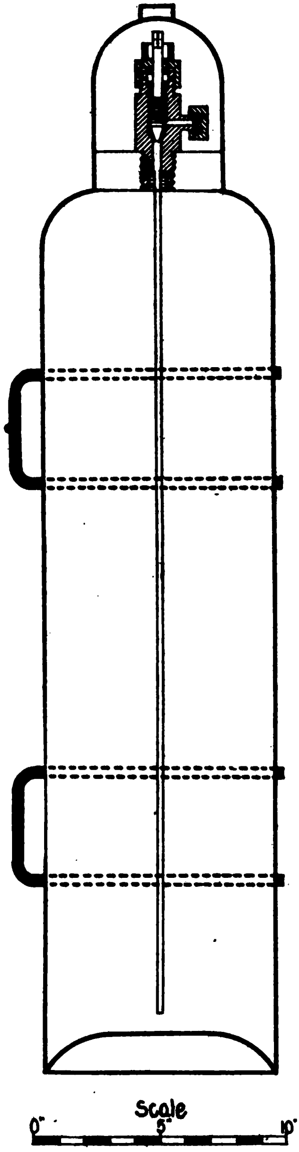

FIG. 1.

Typical gas cylinder.

fitted with a siphon tube passing nearly to the bottom and terminating in a valve at the top, the valve being protected by a screw-on dome during transit or when not in use. The siphon tube is necessary to cause actual liquid to be discharged into the air where it vaporizes and prevents the cooling and slowing down of the discharge, which would inevitably follow if the evaporation took place within the cylinder.

15. The cylinders are transported and used unboxed, but are not dangerous on this account. The pressure inside is low (never more than 10 atmospheres), and the cylinders are tested to five times the pressure they are to stand. They are not liable to burst except by direct hit from a shell or from large shell fragments.

To facilitate their carriage and installation the cylinders are fitted with two handles as shown in the figure.

16. Besides the larger size of cylinders mentioned above, the French have small cylinders weighing only 55 pounds when full, these being used to facilitate the carrying out of surprise attacks. These cylinders are furnished with straps, so that they can be carried on a man's back.

GASES USED.

17. The gas used in cylinders is generally similar to that of the Germans, i. e., a mixture of chlorine and phosgene (cf. Part I, p. 15). The mixture employed is one containing the optimum percentage of phosgene, so that a cloud containing the highest possible concentration of the latter gas is produced, phosgene being regarded as the most deadly of the gases available for cloud attacks. Chlorine alone is now hardly ever employed.

In some cases the gas is mixed with a proportion of smoke-producing liquid so as to form an opaque cloud.

PRELIMINARY WORK FOR A GAS CLOUD ATTACK.

RECONNAISSANCE.

18, A thorough reconnaissance is necessary to determine the most suitable terrain for a cloud attack. An approximate decision can be arrived at by examination of a map of the country. Generally speaking, hilly country or country with marked underfeatures is unfavorable, though not prohibitive. A gentle downward slope is most advantageous. The prevailing wind direction, rainfall, etc., must also be noted.

Personal reconnaissance of the ground, preceded by a detailed examination of aeroplane photographs and large-scale trench maps, must be made, particular attention being paid to the alignment of the trenches of both sides. A short distance between the trenches is best, but care must be taken not to locate cylinders where a slight change of wind will allow the gas to pass into the trenches of the offense. Change of direction of the cloud, due to elevation, woods, streams, etc., must be guarded against.

A special map prepared for the operations must show communication and support trenches, roads, tracks, positions for dumps, etc., so as to avoid congestion, confusion, and interference with the infantry, etc. The communication trenches should be in good condition and adequate for carrying in the cylinders.

CHOICE OF TARGET.

19. Enemy troops with inferior discipline, inadequate gas-defense training, or with poor or insufficient gas-defense appliances naturally form the best targets. A strongly held position will provide the greatest number of casualties, but such a position will probably best be attacked with projectors (q. v.). It must be remembered that a gas cloud is practically continuous in space and that it may be advantageous to employ this form of attack on weakly held fronts in order to affect everybody in the area. This causes a wider-spread distribution of casualties, neutralization, and reduction of morale than could be assured by the use of projectiles, which are more useful for specific targets and thickly held fronts.

In favorable circumstances a gas cloud may still be strikingly effective 10 miles from the line of discharge. This effect should be borne in mind in making a choice of location.

TRANSPORTATION OF CYLINDERS.

20. The cylinders are generally carried into the trenches by the infantry, two men per cylinder and four men per 20 sets of pipes and connections. The American and British practice is for the men to pass a pole through the two handles and hold the cylinders in position with rubber cleats for carrying over their shoulders. The carrying parties, each of which is under a noncommissioned officer, are conveniently made up into one detail for every 25 cylinders. Traversed trenches should be avoided as much as possible, as traverses increase the distance and difficulty of the carry.

Carrying should be started in time to finish two full days before the date fixed for attack. The number of cylinders carried each night is regulated by the transport, carrying parties, and communication trenches available. Under ordinary conditions the carrying and placing of 600 cylinders per divisional front is a very good night's work, though more may be carried in an emergency if carrying parties can be provided.

The full details of the carry are arranged by the officer commanding the gas troops concerned, who provides supervising officers at the dumps and in the trenches.

INSTALLATION.

21. The British practice is to install the cylinders in emplacements dug in under the parapet of the first-line trenches. The emplacements are skeleton wooden cases made to hold four cylinders each. Their construction entails a great amount of work. As a rule, cylinders average one per yard of front, but if a special concentration is desired and space can be found in the trenches the cylinders may be staggered thus:

0 0 0
0 0 0 0

or banked thus:

0 0 0 0
0 0 0 0
0 0 0 0

To reduce the interference with troops in the front line, cylinders are frequently installed in alternate bags, but care must be taken in placing the cylinders in position to make sure that reentrant traverses are avoided so that the neighboring trenches will not be gassed. The gas issuing from the jet comes out at an angle of about 15°.

The cylinders are placed quite upright to get the best effect from the siphon tube and are then thoroughly sandbagged for protection and concealment.

22. The French practice is to concentrate the cylinders in specially prepared, well-ventilated, double-entrance shelters situated at intervals in the front line. These shelters have at least 3 meters of head cover and are made to contain anywhere from 18 to 72 cylinders.

WEATHER CONDITIONS.

23. Weather conditions are of extreme importance in launching a gas cloud. Naturally wind is the controlling factor, for it conveys the gas to the enemy's trenches. Its direction and velocity must be considered.

The direction of the wind should never vary more than 45° on either side of the line perpendicular to the direction of the trench line.

Its velocity should be more than 4 miles per hour and not over 15 miles per hour. There is now a decided tendency to release gas clouds in a much lighter wind than in the earlier attacks.

Wind velocities of less than 4 miles per hour are dangerous, as they are apt to be variable in direction.

Wind velocities of more than 12 miles per hour, though generally stable, may blow in squalls and dissipate the wave. The best results are obtained with a speed of 6 miles per hour.

24. A cloud attack is not launched in heavy rain, as the gas is dissolved, its concentration decreased, and its toxic effect thereby reduced. A light rain is permissible. Mist may be used to conceal the cloud.

25. Sunshine interferes with cloud attacks since the rising hot-air currents engendered dissipate the gas and thereby reduce the toxic action. Gas attacks are consequently best made at night or in the late evening or early morning.

26. Cloud attacks are especially effective in woodland where the wind is a less disturbing factor and the gas lies for long periods.

ACTION IMMEDIATELY PRIOR TO THE ATTACK.

27. The gas troops take up their positions at least 12 hours before zero. Wind reports from the meteorological stations are supplemented by continuous readings of wind direction and strength in and near the front-line trenches. The local readings are usually taken by the section commander (a commissioned officer), who sets a limit of wind direction for each individual emplacement.

28. If the reports are favorable, the pipes and connections are fixed. The British practice is generally to use a four-way connection, so that the four cylinders in an emplacement are coupled up to a single iron parapet pipe about 5 feet long. Occasionally two-way tubes are used, and in special circumstances a single pipe may be fitted to each cylinder separately. The connecting tubes are of rubber. The parapet pipe, which is fitted with a suitable nozzle, is either bent over the parapet and clamped or sandbagged in position, or else actually passed through the breastwork of the parapet.

29. In the French method sets of six cylinders are connected by a common feed pipe to a lead parapet pipe, which leads out of the shelter and over or through the parapet.

THE ATTACK.

30. All connections should be fixed ready and all joints tested at least half an hour before zero. If the latest reports show the wind still favorable, the division is notified, direct notice being sent to any infantry in the neighborhood. Half an hour before zero, with the exception of sentries and machine gunners, the infantry evacuate the trenches. (In the French Army the Z companies take complete charge, from the beginning, of the section of trench in which gas work is going on, so as to diminish as far as possible the chances of a prisoner made by the enemy during a raid disclosing the fact that a gas attack is in preparation). All personnel in the trenches wear gas masks. The French gas troops are provided with the special Tissot mask (cf. Part II, par. 31). One-quarter hour before zero it is impossible to send back any further wind reports, and the section commander must decide whether or not to make the discharge. If the wind shifts suddenly it may be inadvisable for any particular battery (i. e., 20 cylinders) or section to be discharged. A final inspection must be made and the flexible connections examined carefully, to see that none has been cut by shell fragments.

The typical organization of a section for dealing with 100–200 cylinders in the trenches is shown in figure 2. There are three men (with or without a noncommissioned officer) to each battery. One man can turn on about eight cylinders in quick-enough time.

31. At zero the cylinders are opened. All watches must have been synchronized beforehand.

The time required to empty four cylinders (British) through a four-way valve is about 15 minutes, and for two cylinders through a two-way valve about 7 or 8 minutes. The time depends largely on the temperature.

32. The gas troops remain in the line until all cylinders have been emptied, but the pipes are not disconnected until at least half an hour after the attack, as some gas remains in them for a considerable time.

TACTICS.

33. The scale in which the attack is carried out varies. As few as 100 cylinders may be used and as many as 6,000. The length of front on which the attack is made may vary from 100 yards up to several miles.

Cloud attacks may be made on both assaulting and non-assaulting fronts. In the former case the discharge from cylinders is made as soon before zero as is compatible with the disappearance of the gas, so that the enemy can not under the circumstances replace his casualties. Resistance is thereby weakened and advantage taken of the resultant confusion.

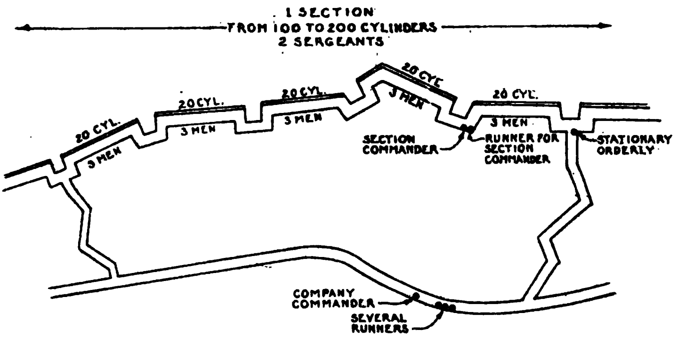

FIG. 2.

The weakness of the cloud attack as an immediate preface to an assault is that the entire coordinated attacks of infantry and artillery can not be left dependent on the direction and velocity of the wind, and no fixed hour could be set very far ahead. For this reason arrangements for an assault are generally made independent of the gas attack.

34. Of the three principles mentioned previously as embodying the present aims of gas offensive, viz., surprise, exhaustion, and penetration of the enemy's masks, surprise is by far the most important in the case of the gas cloud.

For a *surprise* effect the attack must be sudden and short, the object being to surround the enemy with gas of high concentration before masks can be adjusted. Secrecy of preparation is of paramount importance. Every care must be taken, both by the carrying parties and the gas troops, to prevent any metallic ringing caused by the cylinders striking against each other or by the domes being unscrewed or the pipes adjusted. In order to prevent noise, the French bring the cylinders to the shelters entirely covered by a thick burlap cover. One of the most irritating features encountered in launching a cloud is the whistling of the escaping gas from the pipes. This reduces the chances of surprise, and, though much attention has been given to this problem, no solution has yet been found. To veil it a carefully planned machine-gun fire immediately precedes and continues through the time of gas discharge. Secrecy is the more difficult to maintain the closer the trenches are together. The military advantages and disadvantages of close proximity of the enemy trenches must therefore be carefully weighed. The concentration is higher and the cloud takes a shorter time to travel, but surprise due to secrecy of preparation is more difficult to effect.

A night discharge is desirable, and the artillery action should be delayed so that the enemy will come out and man the trenches.

35. Variety in the method and details of the attack is practiced as much as possible, as the Germans almost always attack or await an attack in just one way. Variety in the number of waves, in the hour of discharge, in the use of smoke, either separately or mixed with the gas, and in the nature of the gases used are all studied and practiced. The use of smoke is dealt with fully in a separate pamphlet.

36. Exhaustion of the enemy masks may be regarded as an almost impracticable operation at present owing to the amount of gas required and the fact that the cloud would have to be blown continuously for several hours at a stretch.

37. Penetration of the enemy's masks with the chlorine-phosgene mixture can only be accomplished if the masks are defective from rough usage or from any other cause. This can not be depended on, but there is always a certain proportion of defectives; for example, after the enemy's disaster from his own gas cloud at Hulluch in April, 1916, he reported that 11½ per cent of all unused masks in the western front were not gas proof.

COOPERATION WITH OTHER ARMS.

38. Before an infantry attack the gas troops are withdrawn from the front line, leaving only small parties to look after connections, etc., and thus prevent leaks into the trenches.

The length of time between the discharge of the wave and the infantry attack is very variable, depending on weather conditions, the number of waves released, and the part allotted to the artillery. Orders generally forbid the infantry to attack until two hours after the release of the cloud, and even then the mask may have to be worn.

From captured German documents it is known that the German orders require all troops in the trenches to leave the dugouts and man the parapets when the gas alarm is sounded. Taking advantage of this information, the artillery should open fire on the trenches with high explosive and shrapnel shell after the gas wave has arrived.

When the gas wave has passed on and the enemy can again seek shelter in his dugouts another wave may be launched, to be followed again by artillery fire, or a harmless smoke wave may be launched, followed immediately by another wave of gas. In the meantime a heavy barrage fire is kept up in order to prevent the bringing up of reserves to repel any infantry attack which is intended to follow later on.

RAIDS.

39. Even if no infantry assault in strength is made subsequent to the gas attack it is desirable that patrols should be sent out or a small raid made in order to ascertain the effects and obtain prisoners, if possible. Such a raid, if carried out, might profitably be accomplished under cover of flank smoke barrage while gas continues to be discharged against other parts of the line. The raiding party should include one or two members of the gas personnel.

RESULTS OBTAINED.

40. A surprise cloud attack under favorable conditions is capable of being a military disaster to the enemy. A captured German document states that 15 per cent of the total casualties of the units exposed must be expected from a surprise attack, and 10 per cent even when the attack is regarded as probable.

This figure is largely confirmed by the information obtained from prisoners' statements, captured documents, and direct observation.

Against troops protected by carefully constructed breastworks it is estimated that the gas will produce a number of casualties to equal which would require twenty-five to fifty times the gas weight in shell.

41. A mass of evidence has been accumulated on the effects of allied gas attacks. The following extracts are merely indicative of the results obtained in individual gas-cloud attacks:

NIEUPORT, OCTOBER 5, 1916.

> 42. It was thought that the first German naval division opposite might be found inexperienced in defense against gas, as it was known from the repeated statements of prisoners that a gas discharge in the neighborhood of the sea was considered impossible by the German commanders.
>
> The operation was successfully carried out after a fortnight's delay due to unfavorable winds, 1,800 cylinders of white star gas being discharged.
>
> After a successful raid made by the Germans a few days before the attack, it was no longer hoped that a surprise would be effected, and the behavior of the enemy when the discharge commenced left no doubt as to his being fully prepared for the operation. There was no particular reason at the time for supposing that any damage had been done by the gas.
>
> 43. A man of the First Matrosen Regiment, who deserted early in March of this year, gave the following information:
>
> For some weeks last autumn listening posts in the Polder sector had reported sounds of hammering on metal in the adjacent hostile trenches. On the evening of October 2 a party of the Second Battalion, First Matrosen Regiment (then in the front line of the Polder sector), consisting of 10 volunteers from each company, together with a detachment of pioneers, left with the following orders:
>
> (1) To establish what unit was in front of them.
>
> (2) To destroy machine-gun positions if possible.
>
> (3) To ascertain the meaning of the hammering and what preparations were being made.
>
> The deserter himself saw the party leave about 6 p. m. and return 20 minutes later with about 20 prisoners. The

raiders reported that preparations were being made for a gas attack. *Prior* to October 2 there had been no special gas-alarm orders. No one thought gas attacks were possible because the coast winds changed so frequently. *After* October 2 standing orders for gas alarms were issued to all units, and a gas attack was expected daily, except on the 5th, when the gas officer of the deserter's battalion reported that the wind was too strong. The deserter subsequently heard this officer say that he had been taught that gas would be broken up and rendered ineffective in any wind more than half as strong as that of October 5.

44. The following was the distribution on the night of October 5:

SEA SECTOR. FIFTH MATROSEN REGIMENT: All of the Third Battalion in the act of relief, the resting battalion having come from Ostend to take over the position.

POLDER SECTOR. FIRST MATROSEN REGIMENT: First Battalion in the front line; Third Battalion in Ostend; all of the Second Battalion on fatigue, i. e., off loading cement, stones, and gravel at the embankment on M 17, reloading on to field-railway trucks and pushing the latter into the front line.

LOMBARTZYDE SECTOR: Two battalions of the Fourth Matrosen Regiment distributed in a similar manner as the First Matrosen Regiment, i. e., the First Battalion in the front line, the Third on fatigue, the Second in Ostend.

BAMBURG SECTOR: One battalion of the Second Matrosen Regiment.

45. The gas affected all sectors, but principally Polder and Lombartzyde. Two battalions of the Fifth Matrosen Regiment were in the front trenches, which the gas apparently missed. The gas also apparently missed a battalion of the Second Matrosen Regiment.

At 11 p. m. on October 5 the deserter, with a platoon of 37 men, was pushing a truck about M 15 and heard the gas alarm sounded. All put on their masks. The gas came on them so quickly that some had insufficient time, the masks of others did not fit, and many others tore their masks where the respirator is attached to the material. Seventeen of the above 37 were gassed, of whom 10 died on the ground and the remainder have never rejoined.

The deserter attributed his safety and that of others to finding an adjacent dressing station, protected by a gas-proof curtain, where all stayed till 2 o'clock, when the attack was over. The remainder of that night and all the following day and next night hundreds of dead and gassed were being carried out of all parts of the Polder and Lombartzyde sectors on to the road M 15 A B and M 10 C. Deserter's Seventh Company was 180 strong on October 5, and lost 68 gassed, of whom the majority are known to have died. Deserter believes that all eight companies of his regiment suffered similarly, as did also the reserve battalion of the Fifth Matrosen Regiment, while the Fourth Matrosen Regiment and First Marine Pioneer Company suffered still more heavily.

46. No one actually believed in the possibility of a gas attack before October 2, and the men had not been adequately trained in the gas alarm, nor had their masks been properly fitted and tested. The masks did not fit and were of much inferior quality to those now issued. The respirators were so bad that men with weak lungs were forced to remove their masks. The fatigue battalion of the Fourth Matrosen Regiment had left their masks with their rifles and packs, and the First Pioneer Company had left their masks in Middlekerke. The deserter heard the divisional chaplain say at church parade on October 8 at Ostend that the division had to deplore the loss of 700 men dead after the recent gas attack, all of whom were buried in the divisional sector. This is apart from gassed cases sent to Ostend and Bruges, of whom many died en route and in hospitals, owing to the lack of adequate appliances for treating such large numbers quickly enough. It was currently estimated in the First Matrosen Regiment that there had been 1,500 gas casualties in the division, counting the five battalions principally affected and the divisional units, of whom the great majority ultimately died.

47. The gas was so strong that, after the attack, deserter's company could not unlock the bolts of their rifles, and all metal arms and equipment of his battalion were rendered unserviceable and handed into store. The rifles and side arms were described "as if they had been in a well." The gas seemed to come in six separate waves and the effects were felt as far back as Raversyde.

Several transport horses of the pioneers were killed in Middlekerke.

Many dugouts in this sector now have gas-proof curtains fitted and the gas masks have been changed, fitted, and tested.

MONCHY, AUGUST 30, 1916.

48. One thousand one hundred and sixty-seven cylinders used; attack made at night. Results: Three German regiments affected, the Twenty-third, Sixty-third, and Ninety-first Reserves.

A prisoner of the Sixty-second Regiment examined by the Third Army stated that there were quite a number of deaths from this gas attack in the Twenty-third Regiment.

49. Three prisoners of the Twenty-third Regiment gave separate accounts of the gassing of half a company of the First Battalion behind the lines near Ayette at the beginning of September.

Prisoners A and B agreed on most points. They stated that the attack took place about three months ago in the evening. One company was at training (exerzieren) and had no gas masks with them. The gas came along quickly and about half the company were killed. (B said "over 60 were killed".) Their own company was not affected. It was reported that the gas had come over in shell. After that there were more stringent rules about always carrying masks in the villages behind the lines. They had no recollection of a gas alarm having been sounded.

Prisoner C stated that his company (Fourth Company) was in and around Les Ayettes (pointed to Douchy-les Ayettes on the map) about the beginning of September, when late one evening gas came over so suddenly that they thought it came from artillery fire. The gas was terribly strong and they had very heavy casualties, for no one was expecting gas and very few men were carrying their gas masks. There was no special drill or training being done, and over 60 men were killed through not being able to get to their respirators in time. No warning was given, though the gas alarm was subsequently given by ringing church bells. Many of the men killed were orderlies, servants, etc., who found it difficult to always carry masks.

This regiment was behind the lines at the time of the attack. Two prisoners examined by the Third Army stated that "the effects of the English gas are said to be appalling."

50. A prisoner of the Sixty-third Regiment stated that the men did not use their masks properly and also said that a fatigue party of 10 men of his company who had gone up on the night of the attack had all become casualties.

A prisoner of the Sixty-second Regiment stated that there were a number of deaths in the Sixty-third Regiment.

ARRAS, OCTOBER 8, 1916.

51. One thousand two hundred and sixteen cylinders used. Results: Three German regiments affected, the Ninetieth Fusilier Regiment, Ninetieth Regiment, and One Hundred and Sixty-third Regiment.

52. A lance corporal of the Ninetieth Fusilier Regiment taken on October 25–26 stated: "Two or three weeks ago when gas was let off south of the river there were about 25 casualties in the left company of the Ninetieth Fusilier Regiment. Most of these 25 died."

53. A prisoner of the Ninetieth Regiment stated that large numbers of men were gassed. In the First Company there were 25 severe cases of whom 23 died within two hours. The Second Company also had severe losses. In addition to the immediate casualties there were many cases of delayed action. Other companies also suffered, but the prisoner had not learned details. The moral effect of the gas was great.

FRELINGHIEN, APRIL 29, 1917.

54. A "sanitater" of the Third Battalion, Ninth Bavarian Regiment, remembered having seen at least 40 gas cases, most of them very serious, through his medical dugout. He did not know whether any died, as they were all rapidly taken out. These probably all came from one battalion. He could not say what the total casualties of the regiment were. Men were forbidden to discuss casualties arising from gas.

MONCHY, JUNE 27, 1916.

55. Several prisoners of the Second Battalion admitted that they had been through a gas attack at Monchy. They remembered the exact date, times, and nature (two waves) of the attack, but they persisted in stating that the gas caused them no losses at all. One prisoner, however, on being isolated, stated that he was sent with a message to a battalion medical dugout. There he saw about 20 men lying down in the dugout and there were about 30 lying outside in the trench. A medical noncommissioned officer told him they were gas cases. The prisoner would give no information regarding casualties in his own unit. (Information had been previously obtained to the effect that the regiment suffered many losses from this gas attack.)

REPRESENTATIVE STATEMENTS OF GERMAN PRISONERS.

56. Prisoners taken at Maurepas and examined by the French Army stated that one of the English gas clouds was effective 10 kilometers back. There were numerous men who died in the trenches, and others who were made ill and evacuated. Some were taken ill only after several days. One died suddenly two days after, while writing a letter. The prisoner's company suffered greatly by having to work and move about in their masks.

57. Two prisoners of the Sixty-second Regiment (Second Company and Ninth Company) stated that they had very heavy losses from gas on July 1 on the Somme. In the First Battalion nearly half the battalion was gassed (killed or sent to hospital). The Third Battalion also had very heavy losses. The attack took place early in the morning and was a complete surprise. The gas was not very strong, and a great many of the gassed cases returned to duty within a week, though a number died. In the Second Company there was a total of over 100 gassed cases.

58. The diary of a man of the Eighteenth Reserve Division (probably the Eighty-sixth Regiment) states: "June 28 I went to look for a pump and so came past the Thirty-first's aid post. Inside lay a whole heap of men who had been poisoned with gas during the night." Further entries in this diary (dated July 17 and Aug. 4, 1916) showed how demoralized the writer's regiment was with regard to gas, and that men got into a panic whenever the word "gas" was called out.

59. Prisoners in the Ninety-ninth Reserve Regiment stated that there were a number of gas casualties. One stated that the younger men suffered most severely, as they were careless with their masks, and got excited, but the majority attributed their losses to ill-fitting masks and lack of time in putting them on. Several prisoners remarked on the number of delayed cases.

60. A number of prisoners of the One Hundred and Sixty-ninth Regiment all gave the same information: "The attack was a surprise and the cloud came over and passed fairly quickly. The whole thing did not occupy more than 10 minutes. They had about 140 gas casualties in the battalion, including 20 men who were out on patrol, and who were all killed, as they had no gas masks with them."

61. The special correspondent of the Vossische Zeitung wrote:

"I devote a special chapter to this plague of our Somme warriors—the horrid nuisance of poison gases to which they are perpetually exposed. It is not only when systematic gas attacks are made that they have to struggle with this devilish and intangible foe. The English have fallen so deeply in love with this atmospheric weapon that they incessantly claim its help. Their artillery is no longer satisfied with the ordinary explosive shell; the air also has to be made foul.

"Wherever they go on the battle front, our troops have to defend themselves against the disgusting and uncanny effects of the gas shell. From the battle positions to the preparation quarters and reserve quarters, and even farther back through the whole area of the enemy's fire, this invisible and perilous specter of the air threatens and lies in wait on all the roads leading to the front. In the trenches themselves it is particularly unpleasant, because here it settles down and can not easily be dissipated by the wind. But even in the open country it pursues its course and tortures human beings."

62. At a course of instruction for noncommissioned officers at the end of 1916 (after our large cylinder operations on the Somme) a prisoner of the Eighty-sixth Reserve Regiment was told by the antigas officer that, in a cloud gas attack, the "mean total casualties of 15 per cent of the unit exposed must be reckoned with."

63. A prisoner of the Fifteenth Reserve Regiment was in a large hospital in the Exhibition Building at Ghent, during the period from July 31 to August 20, 1917. This was one of the large special hospitals for slightly wounded and gas cases, and held at that time about 2,000 cases in all. The prisoner himself saw a great many gas cases there, and he was told by a medical noncommissioned officer employed in the hospital that of the 2,000 patients nearly half the cases were due to gas poisoning.

PROJECTOR ATTACKS.

GENERAL PRINCIPLES.

64. The cloud method of gas attack suffers from the following disadvantages:

(*a*) It is very dependent on weather conditions, the limits of wind direction available being very narrow.

(*b*) The installation and carrying in of the cylinders is largely dependent on infantry working parties. The use of the front line and communication trenches by the gas troops may also cause a certain amount of confusion and disturbance of other arrangements. The cloud attack is therefore dependent on other branches of the service to a considerable extent.

(*c*) The concentration of gas obtainable by the cloud method is not very high, and the densest portion of the cloud is that in the immediate neighborhood of the trenches from which the discharge is made.

(*d*) To obtain complete surprise is difficult.

It is chiefly for the above reasons that the British "projector" method of attack has been so highly developed and has now been adopted by the other allied armies.

The principle of the projector attack is to hurl simultaneously into the enemy's lines numbers of large bombs containing liquefied gas. By bursting at the same time these produce very high concentrations of gas.

65. This method was worked out by the British in 1916–17 and has been largely used by them since with very great success. Owing to its success, the enemy since the end of 1917 has attempted to copy the projector attack, and numerous bombardments of this nature have been made against the allies.

DESCRIPTION OF APPLIANCES.

66. In order to provide the large number of mortars for the simultaneous firing and to permit a mobility unobtainable in an ordinary type of gun or mortar, capable of firing large-sized shell, the gas bombs are fired from steel tubes buried in the ground. These tubes are known as projectors and are of various sizes, but those of 2 feet 9 inches and 4 feet are almost exclusively used by the British. The former weighs 100 pounds, the latter 195 pounds.

The projectors are set in the ground at an angle of 45°. As a rule the tubes rest on base plates, which prevent the guns burying themselves on recoil and also gives greater range due to the rigid bottom. If no base plate is used, the gun may bury itself 2 to 3 feet in the ground in some places, whereas with a base plate it will go in only 6 inches, and several shots may be fired from the same gun. The type of base plate used is shown in figure 3. It weighs about 30 pounds and is fitted with two holes for carrying ropes.

67. The propellant charge is supplied, ready-made, in a tin box, partitioned in such a way that the size of the charge can be altered at will, the powder being put up in numerous small bags of known weight. The charge varies from 12 ounces up to several pounds, according to the range desired. Both black and smokeless powders have been used. The top of the propellant container is concave to allow the bottom of the bomb to fit into it.

The propellant charge is fired electrically by a detonator buried in a small charge of black powder placed in one of the powder bags. The leads pass up the inside of the tube and thence to the exploder.

68. The type of bomb used is shown in figure 3. When loaded it weighs about 60 pounds and contains approximately 30 pounds of gas. It is burst by a regulated explosive charge contained in a central tube which is screwed into position and runs nearly the whole length of the drum. The firing is done through a time fuze fired by a pistol head, shear wire, or other suitable device, the length of fuze being accommodated to the calculated time of flight. For maximum range the fuze burns 25 seconds.

THE GAS.

69. The gas used may be varied, but inasmuch as up to the present the best results have been obtained by the use of unmixed phosgene, this material has been employed almost exclusively.

The projectors are also used for incendiary purposes, being filled with inflammable oil, when intended for such use.

INSTALLATION.

70. The carrying in of the projectors, bombs, and accessories is conducted in a way similar to the carrying in of cylinders. Each night a certain number of tubes are carried in, set, filled in, capped, and camouflaged. After installation, one night should be sufficient for loading, wiring, and firing.

For carrying in, the tubes are roped on poles, two men being assigned to each tube. On arrival at the position they are placed in shallow trenches dug to accommodate about 20 tubes, the trench being carefully sited as to direction and dug out at the required angle so that all that is necessary is to slide the guns into position. First, exact elevation is obtained by means of a clinometer, then without disturbing the elevation the tubes are set for direction on a line accurately laid by compass. After

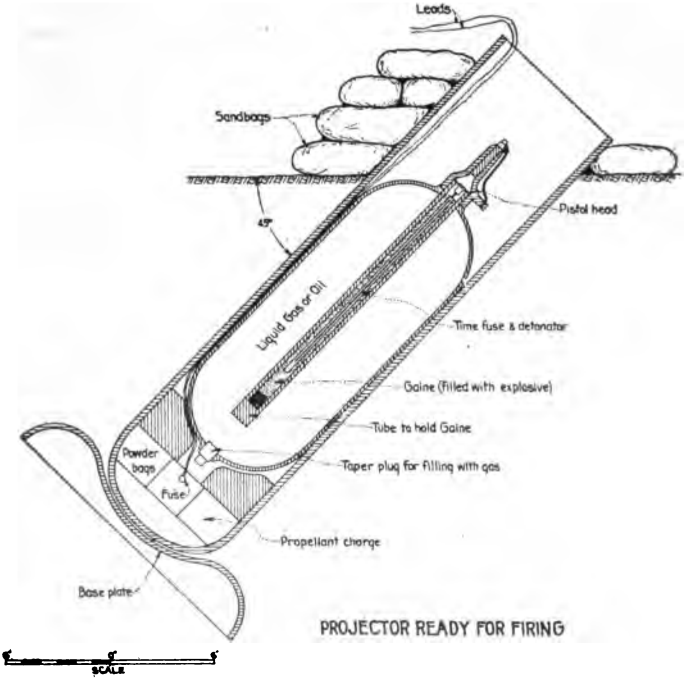

FIG. 3.

setting the guns, the earth is filled in around them and tamped. They are capped to keep out rain and dirt, and properly camouflaged.

The projectors are usually installed between front and support lines, or even behind the latter, but sometimes they are placed in trenches in which case they are let into the parades.

71. On zero night the propellant charges are placed in position. The wires are bent over the tops of the tubes and the bombs placed in the guns. The wiring is then completed, the leads being arranged to fire each battery in series, the wires being taken back to a central control. With the use of a switchboard one exploder can be used to fire a number of batteries, and this has the advantage of surprise, since all the projectors are fired at once, and thus the difficulty of time synchronization is largely overcome.

THE ATTACK.

72. The technique of the attack itself is simple and consists only of the electrical firing from a central dugout. If firing is carried out from more than one position, absolute coordination is essential, so that the enemy is not given warning by the noise of discharge from one set before the others are fired. Troops in the neighborhood must be warned of the attack, but evacuation of trenches by the Infantry is not necessary. Direction and strength of wind are not so important as in cylinder attacks. The limits of direction allowable must be decided by local conditions of alignment of the trenches of the offense and the position of neighboring troops.

Tactics.

73. Projectors are used against definite targets, generally against points or areas which form positions strongly held by the enemy and where living targets are numerous. The number of bombs fired is determined by the size and nature of the target and may vary from a hundred or so up to several thousands. The range obtainable with the latest type of tube and propellant is over 1,800 yards, but an average range may be taken as 800 to 1,000 yards. Increase of range means that the tubes can be installed farther back, with consequent less disturbance of the men in the trenches and greater ease and convenience in carrying in and installation. Without base plates the ranges are about 10 per cent less than where base plates are used.

Although greater accuracy is frequently obtained, it is necessary in choosing targets to assume that the error of range will be 5 per cent of the distance and that the lateral error will be 7 degrees.

74. As in all methods of gas warfare, the greatest secrecy must be maintained in order to get the maximum surprise effect. Careful camouflaging of the projector positions and of all tracks leading to them is essential, so that the preparations are not betrayed to aeroplane observers.

TRANSLATION OF SELECTED GERMAN INSTRUCTIONS ON DEFENSE AGAINST OUR PROJECTOR ATTACKS.

75. *New English "gas-mine" projector.*—Since the beginning of April a new English gas mortar (projector) has been noticed, in continually increasing quantities, on the western front, particularly on the Fourth Army front.

The most thorough precautions must be taken against this mortar, owing to the enemy's method of using it and its high degree of effectiveness.

76. *Effects of the projector.*—In this new "phosgenmine" the British possess a very effective means of throwing large quantities of highly poisonous gases, dangerously concentrated, on to our positions. The percentage of gas in the air at the moment and place of explosion may be best compared to effects noticeable on the sudden vaporization of the contents of a small gas cylinder (Gaskampfflasche).

The effects, however, are not confined to men directly in the bursting area, but are noticeable for a considerable distance around.

77. *Enemy tactics.*—The British use this "gas mine" very cleverly. When the weather conditions are suitable, especially at night, the projectors are thrown, in a sudden burst of fire, in salvos of six or more, on to our front-line trenches.

This is usually preceded by an apparently normal bombardment with 10.5 centimeter projectiles or smoke bombs; projectors (containing lachrymatory and other gases) are fired at the same time as the "phosgenminen;" sudden bursts of fire often follow a slow continued bombardment.

Dugout entrances, noncommissioned officers' posts, wiring parties, trench reliefs, etc., are looked upon as specially suitable targets.

The enemy is particularly on the lookout for groups of men, who betray their presence by noise and loud talking.

78. Protection against gas.—The protection afforded by our mask is complete and reliable. Although considerable losses have been sometimes experienced, the cause is to be found in the well-known mistakes in the use of the gas-protection equipment.

It is impossible to eliminate the possibility of casualties being caused in the immediate neighborhood of the first salvos of gas mines, as but few mouthfuls of this highly concentrated gas suffices to do immense harm to unprotected persons, but rigid gas discipline will reduce losses to a minimum. Everyone must understand that, if subjected to a sudden gas bombardment, it is absolutely necessary for him to put on his mask immediately and keep calm.

79. On account of the effectiveness of this new British gas mine, the mask will always be carried in the alert position when within 3 kilometers of the enemy's trenches, and *under no circumstances whatever* will it be removed.

It is to be put on if the slightest trace of gas be noticed, even if breathing is easy at the time.

Great care must be taken before it be removed. The protected bombardments, of which the enemy often make use, make a lengthy use of the gas mask very necessary.

Hot nights and justifiable apprehension cause profuse perspiration underneath the mask.

The hollow interior beneath the chin becomes full of liquid. In spite of this, the man must and will hold out and must not be tempted to remove this protection until the dispersal of the gas has been certified by an officer.

80. Even during a lengthy gas attack the container will not become exhausted, and therefore must not be changed while the attack is still in progress.

In addition, working parties, men sleeping in dugouts, etc., must be protected by means of gas sentries.

The greatest attention must be paid to having reliable and rapid gas alarms ready in the event of enemy gas attack.

In favorable weather we must reckon with the probability of these gas clouds drifting over our rear positions, so that a distance of at least 10 kilometers behind the front line must be considered a danger zone, and must therefore have a well-organized system of gas alarms ready for gas-mine bombardment as well as for cloud gas.

81. It is especially important that camps, rest billets, etc., be warned immediately by means of gongs.

It is certain that the enemy will make use of these gas mines in considerable quantities in the coming offensive.

He will use this dangerous weapon even more than hitherto for raids on the front systems and to gas important parts in the line.

The inspection of all protective equipment can not be too frequent or too thorough; men must be schooled to a rapid and correct use of their gas masks by continual gas drills.

The most careful watch must be kept day and night in order to avoid casualties through surprise.

The commanding officers of all units are personally responsible for the carrying out of these orders.

(Signed) SIXT VON ARNIM,
General der Infanterie.

ENGLISH 20-CENTIMETER PHOSGENE PROJECTILES.

ONE HUNDRED AND ELEVENTH DIVISION,
August 7, 1917.

82. Since April, 1917, the English have employed a phosgene 20-centimeter projectile. This is 55 centimeters long, with a diameter of 19.5 centimeters, and contains 13 kilos of pure phosgene.

The enemy has combined, in this new process, the advantages of gas clouds and of gas shell. The density is equal to that of gas clouds, and the surprise effect of shell fire is also obtained.

For the bombardment the latter part of the night is generally chosen, with a calm or light wind (the direction of the latter is immaterial).

The enemy aims essentially at surprise. Our losses have been serious up to now, as he has succeeded in the majority of cases in surprising us, and masks have often been put on too late.

83. Protective measures.—All troops must be given detailed instructions on the new method of gas warfare employed by the English and their attention drawn to its dangers, which consist wholly in surprise.

Our mask is absolutely efficient if put on in time and properly adjusted.

Constant training in putting on gas masks rapidly and in holding the breath during adjustment must be practiced.

Gas regulations must be strictly observed in the front-line position.

It is essential that men can count on the alarm being rapidly given in every sector.

Men must be better trained to observe atmospheric conditions.

Special instructions must be given to all trench observation posts.

84. As soon as a loud report like a mine is heard 1,000 to 1,500 meters away, give the gas alarm.

The projectiles are several seconds in the air. Time should be employed as far as possible in giving the alarm and putting on masks.

It does not matter if several false alarms are given. Masks must not be taken off without orders from an officer. Men affected, even if apparently only slightly, must be treated as serious cases, laid flat, kept still, and taken back as soon a possible for medical treatment.

85. Antigas officers and company commanders will go through a fresh course of training on the above principles.

(Signed) VON BUSSE.

COMPANY ORDER OF A UNIT IN THE EIGHTIETH RESERVE DIVISION, DATED SEPTEMBER 6, 1917 (AT THAT TIME IN PILCKEM SECTOR).

86. Latterly we have suffered numerous losses through bombardments with gas trench-mortar projectiles. These projectiles are always fired in conjunction with bursts of artillery fire, and are therefore not recognized. They produce a very strong effect by intense concentration of gas.

The chief danger is the element of surprise.

Our mask affords complete protection.

These gas bombardments always take place in the early morning hours, when the wind is in the direction W., SW., NW. When, therefore, bursts of fire occur during the night, particularly after midnight, which might indicate such gas bombardments, gas masks must be put on at once.

When a gas bombardment takes place, the whole sector and neighboring sectors are always to be alarmed.

Men are to be specially warned against taking off their gas masks too soon.

ORDER OF SEVENTEENTH BAVARIAN R. I. R., SIXTH BAVARIAN RESERVE DIVISION, DATED JULY 22, 1917 (AT THAT TIME IN SECTOR EAST OF ZILLEBEKE).

87. (*a*) Recently working parties entered the area of a battery which had been bombarded with gas projectiles and suffered considerable losses, the reason being that there was no gas alarm.

When a battery is gassed, the signals (bells, gongs, etc.) in the battery position are to be sounded, not only to alarm its crew but also to warn people in the neighborhood.

(*b*) The same applies to the acoustic gas-alarm signals in the front line. The danger that the enemy will in this way ascertain the position of our front line is less than the danger of giving the gas alarm too late.

(*c*) Troops are again to be warned to exercise the greatest caution as to "blinds" which may fall near them, as these may often be gas projectiles which look like blind shells.

(*d*) Under the supervision of gas officers, troops will practice the adjustment of their gas masks daily. This will be carried out as a parade and practiced in every position, with every kind of equipment, in every degree of preparedness, etc. (Time, according to state of preparedness, 2 to 6 seconds.) The men must hold their breath.

(*e*) In all urgent cases of gas alarm, commanders will at once order the wearing of the mask on the sling without its container, which is permitted under exceptional circumstances.

[Corps H. Q., 23–6–17. (Ypres Group.) 111th Bavarian Corps. G(as) O(ffizier) Nr. 26,545. (To be handed over on relief.)]

88. *Danger zones.*—Danger zone of hostile gas is fixed at 10 kilometers distance from the enemy's front line.

In the trenches exposed to hostile fire from Minenwerfer, men are in no condition to be allowed to sleep at night.

(Signed) HAACK, *Lieutenant Colonel,*
(For Chief of General Staff.)

[Corps H. Q., 18–7–17. (St. Quentin Group.) G(as) S(chutz) O(ffizier). Pi(oneers). No. 11871.]

NOTICE.

89. Warning concerning gas mines.—The enemy, by means of these gas mines, can envelop our trenches—in a minimum of time and even with a contrary wind—with a heavy, dangerous gas cloud, which remains for a long while in our positions.

Men are to be instructed to put masks on as soon as they hear an unusually loud explosion in the enemy's lines. Delayed adjustment of the mask may lead to cases of gas poisoning, owing to the rapid appearance of the gas.

The mask may be removed only by order of an officer.

Anyone who has breathed gas while unprotected, even if the case appears to be light, is to be regarded as a severe case. Such a case will be placed in a position of rest, and will be carried back as soon as possible for medical treatment.

(Signed) ALBRECHT, *G. O. C.*

NOTES ON INDIVIDUAL PROJECTOR ATTACKS.

90. The ascertained results of a few typical projector attacks are given in the following notes:

THIEPVAL, SEPTEMBER 25–26, 1916.

(One of the earliest attacks was made with only a few projectors.)

91. Projectors were used with good effect against Thiepval on September 25–26, 1916. Statements by prisoners are appended:

Second Battalion, Machine Gun Company.—Gas "mines" fell near prisoner's dugout, where there were about 25 men. Several did not get their masks on quickly and were badly gassed. There were at least seven deaths in the company. There may have been more, but it was difficult to move about and know what was happening. The dugout was easily cleared by means of fire, but the men had to wear their masks three times, for about one hour each time, and it was very uncomfortable.

92. A reservist of the Fourth Company stated that they had lost heavily from gas mines. On the 25th they had over 20 casualties in the company, of which a number occurred in his own dugout. The dugout was deep, but the gas came down into it. They cleared it twice with fire, but it always filled again. Six hours afterwards, when he finally took his mask off to go to sleep he was gassed, though not badly. On the 26th he reported sick and was sent to the aid post at the back of Thiepval. This was a big dugout with three tiers of beds built into it. When he got there he found it full of gassed cases. There must have been 25 bad cases waiting to be sent away. This man was still very bronchial when examined at a casualty clearing station on the 29th.

A corporal of the same company gave very similar evidence. He personally had counted up 17 men whom he knew to have been killed by gas on the 26th.

93. Sixty-sixth Regiment, First Company.—Prisoner stated that there were over 30 gas casualties from bombs, but he did not know how many deaths. The gas was very thick where the bombs dropped.

94. Another company.—There were 26 gas casualties in this company, of which 6 died in the trenches. This was confirmed separately by another man, who stated there were 24 ill, of whom 6 died. An "Unteroffizier" of the First Battalion stated that there were 10 casualties from gas shell which he knew of.

Seventy-seventh Regiment, Second Company.—This company had five or six casualties from gas "mines." Prisoner was slightly gassed in his dugout by residues of gas four or five hours after the bombardment. He had been bronchial on admission to the casualty clearing station, but was quite recovered when examined on June 29, 1916.

BEAUMONT HAMEL AND Y RAVINE, NOVEMBER 12, 1916.

95. Forty-seven bombs were fired into Beaumont Hamel and 39 into Y Ravine on November 12, 1916. The Sixty-second Regiment was chiefly affected. A man of the Fourth Company stated that they had 20 killed and 8 seriously ill from gas mines which burst near their dugouts. He stated that their masks were all right, but these men had not put them on quickly enough. The gas was so "frightfully strong" that safety was entirely dependent on speed in getting masks adjusted.

Fifth Company.—One man of this company stated that they had very heavy losses from gas mines on November 12. He could give no numbers. A second prisoner, a stretcher bearer, stated they had 15 killed from gas and 20 others ill. Most of the killed died immediately, but others died at the aid post. He regarded these gas mines as one of the most dangerous things they had had to meet.

Ninth Company.—A man of this company, whose evidence seemed trustworthy, stated that they had over 25 casualties from gas mines on the 12th instant. Nearly all of these were killed. There were practically no light casualties. Asked the reason for such losses he said that when the bombs burst close to them there was not time to get the masks on. Similar evidence was given by another man of the company, who stated that the gas penetrated into dugouts very quickly and made them uninhabitable.

A " Vizefeldwebel " (assistant sergeant major) stated that one platoon of this company was almost wiped out by a gas mine. An officer and 20 men went to the hospital and 8 men were killed outright.

96. Many dead unwounded Germans were found subsequently in the area bombarded with these T. M. gas bombs. The bodies were examined by a physiologist, who made autopsies and found death to be due to gas poisoning.

Twenty-third Regiment.—A stretcher bearer stated that his company had between 20 and 30 bad gas cases on the evening of November 12. He did not know whether any deaths occurred in the trenches. The cases he mentioned reached the dressing station, but he was of the opinion that most of them would prove fatal.

The prisoner appeared trustworthy, but gave information with reluctance.

CHERISY, MAY 5, 1917.

97. Prisoner of the Eighty-sixth Reserve Regiment stated that toward the end of May they had six men killed and seven or eight men gassed. Only a few gas bombs fell near them. He heard that one company of the Eighty-fourth Reserve Regiment, which was actually in the target sector, had 84 men killed.

Another prisoner was told by his platoon commander that they must take the greatest care of their masks as one company had had 84 men killed.

WIELTJE, JUNE 1, 1917.

98. Extract from translation of captured German battalion order concerning antigas measures. Orders belonged to one of the regiments of the Two Hundred and Thirty-third Division and were dated June 6, 1917:

"At 5 p. m. the company will report all losses which have occurred from gas up to this hour.

"I shall wait for this report till 6 p. m., so that corresponding measures can be taken for providing reinforcements. The effectiveness of gas-alarm arrangements, after the occurrence of to-day, is to be tested and necessary changes are to be made."

(Signed) KLEINKE.
(For Husmann, Bn. M. O.)

FONTAINE WOOD, JUNE 14, 1917.

99. A prisoner of Eighth Company, One Hundred and Ninetieth Regiment, stated that on the night of June 15–16 his battalion was sent up from rest at Dury to reinforce the Ninety-ninth Reserve, one company being sent to reinforce the Third Battalion, One Hundred and Ninetieth Regiment, which suffered severely from our gas attack on June 14, 1917. He heard that in the Third Battalion the Tenth Company had its company commander and 57 killed, and the Eleventh Company had 18 killed. Sick rooms in Saudemont and Ecourt were full of men who had been brought in suffering from gas sickness. In one case a projectile fell just outside a dugout in Rotten Row, containing 25 men, every one of whom were killed.

HOOGE, JULY 16, 1917.

100. Sixteen noncommissioned officers and men of the One Hundred and Nineteenth Division, chiefly of the Forty-sixth Regiment (Aktiv), were interrogated. This division was holding the line from Ypres-Menin Road to the south on the night of July 15–16 when we made a projector gas attack, firing projectors on to Hooge with a southwest wind of 3 to 4 miles per hour.

The Fifty-eighth Regiment was on the flank of the gas attack and had few casualties—five to six per company. One prisoner of the Seventh Company stated that the sound affected, walked to the aid post in the churchyard at Havrincourt (more than a kilometer)."

109. On the succeeding night and on the following day the majority died, although the necessary treatment was applied. The serious effect and considerable number of fatalities make it urgent to insure that in the future more energetic measures of protection be undertaken. All entrances of dugouts must be protected with two curtains, placed at an interval apart.

Even greater emphasis than before must be laid upon the fact that in apparently slight gas cases every movement is attended by the utmost danger.

110. Only when movement can take place without the slightest danger (even regarding transport by vehicles) may gas cases be evacuated by instructions of the medical officer. In the case of increased gas activity on the part of the enemy an immediate increase of medical personnel will be arranged for by the regiment in the affected sectors. If a company or part of a company has been affected by gas, the senior sector officer or regimental commander will see that a relief takes place and fresh troops are brought up. The danger is so great that especially in the sector recently affected the commanders concerned will institute an immediate examination regarding the necessary protective measures, and officers and men will receive detailed instruction.

○